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Commentary

Science Must Embrace Traditional and Indigenous Knowledge to Solve Our Biodiversity Crisis

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Traditional and Indigenous knowledge has successfully preserved and restored biodiversity across the globe. However, its recognition as being as equally valid as Western science as a way of knowing remains lacking. If we are to preserve global biodiversity and rewild key habitats, science and Indigenous knowledge must work in partnership while also being restitutive and rights based.

The nexus of climate change, biodiversity loss, and their associated socio-ecological shifts positions us at a critical crossroads in time. It is clearly too late to prevent global-scale ecosystem change.[1] Approximately one million of Earth's species face extinction risk,[2] and over 80% of the ecological processes that underpin ecosystem functioning and the associated support services to people are already affected by climate change.[3] The global climate-driven redistribution of species, rapidly warming Arctic, acidifying oceans, and many other impacts both on marine and terrestrial ecosystems point to a future full of uncertainties. The unavoidable reality is that new solutions are needed if we are to survive the major changes under way.

However, humans have survived through multiple ice ages and planetary transformations before—largely as a function of Indigenous wisdom and traditional knowledge. Traditional and Indigenous knowledge has informed human societies for hundreds of thousands of years and is embedded and embodied in cultures and communities around the world. Such knowledge is often defined as deep, complex ways of awareness and co-existence with natural ecosystems and is built and adapted over long periods of time. Indigenous knowledge is also very much about the present, rooted in the wisdom of the past—it supports modes of sustainable living in a given place and manifests as oral histories, material and spiritual culture, art, songs, and the presence on traditional homelands. This rich world of Indigenous wisdom and traditional knowledge exemplifies an often-hidden world that still exists across the planet and provides a basis for the well-being and livelihoods of millions of people in communities deeply anchored by their cultures and languages.[4]

However, despite the fact that nature is overall *better* preserved within areas controlled by Indigenous Peoples,[5] Western science seems to more often than not overlook such successes. Yet clearly, in order to survive the present century, we need to embrace Indigenous knowledge, be intimately guided and led by the knowledge holders, and where appropriate, consider it alongside the best scientific understanding of priorities needed to prevent ecosystem collapse. Respecting and embracing Indigenous rights and knowledge will help us plot a brighter course for the future.

Indigenous Knowledge, Resurgent

Indigenous and traditional societies are already, much in their own capacity,[6] on a trajectory of rebuilding their societies, cultures, land uses, and ways of being after centuries of colonial rule and destruction. Indigenous Peoples have repeatedly shown how valuable their knowledge and how successful their management of socio-ecological systems can be. In the European Arctic, the Skolt Sámi have been able to adapt to address rapidly progressing climate change through restoration of rivers previously damaged by man-made changes. By bringing the Vainosjoki River back into health and allowing trout, grayling, and other cold-dependent fish to have access to habitats and spawning areas to choose from, they have created and put in place safe havens with the use of Sámi Indigenous knowledge.[7] Through community-led self-reflection, the Skolt Sámi have been able to choose a regional functional approach to restoring habitats—that were degraded by human actions in the past—for the resilience, food security, and survival of both humans and non-humans in the present.

In addition to restoration of damaged places, equally important are the preserved socio-ecological systems and places that are still safe havens. We know that 80% of the world's remaining biodiversity is located in the Indigenous homelands around the world.[8] In many cases, these sites so critical for biodiversity are also valuable carbon sinks. For example, the Ekuri community in the Cross River State of Nigeria owns the famous Ekuri community forest. It has been involved in formal community forestry since 1982 and has had remarkable successes as a flagship community. This area, totaling 33,600 ha, is the largest and by many measures the best communally managed forest in West Africa. In the Ekuri forest, harvesting timber for commercial purposes is not allowed, and only harvesting for domestic uses (for example, building a house or furniture) is supported. Any harvesting of timber is based on an agreed

management strategy with an inventory and standard guidelines, and the proceeds generated are used for the benefit of everyone in the community, such as for roads, health centers, farming inputs, and education. To aid the speedy regeneration of the forest, farming is permitted only in approved farming zones, and no hunting of endangered wildlife species (particularly those that disperse seeds) is allowed. Water pollution of any kind by any member of the community is banned.

However, these community-managed areas are often threatened by outside interests. The Ekuri community forest is actively under threat from a proposed "superhighway" that is slated to destroy large tracts of the forest itself. At the same time, illegal farming and illegal and unsustainable forestry are chipping away at the forest. To ensure its continued protection, the Ekuri community plans to acquire status as a community conserved area, which will integrate the Ekuri community forest into the network of sub-national, national, and global protected areas. Proper recognition and protection of such Indigenous community lands can play an important role in preserving these socio-ecological systems, especially because many officially non-inventoried locations of high biodiversity value are threatened by extractive uses throughout the world.

Working in Partnership

Examples from across several continents and climate zones—the Arctic, North America, Africa, and Australia—demonstrate the success of Indigenous wisdom and traditional knowledge in helping to protect and restore biodiversity. When combined with the latest scientific advances in ecological understanding, monitoring, and restoration, such knowledge could offer us a way forward on some difficult environmental challenges.

Examples of these partnerships are emerging worldwide. After the removal of two large hydropower stations, the restoration of the Elwha River in the United States has combined the efforts of the science community and the Indigenous knowledge of the Lower Elwha Tribe.[9] This has allowed the return of birds, Pacific salmon, and other species, exemplifying how system-level change for the better can occur when the scientific and Indigenous communities work in partnership. In northeastern Australia, the East Trinity Wetland, a former acidic sugarcane plantation, has been nurtured back to life by the Indigenous Land and Sea Country Rangers of Djunbunti, who worked with government biologists and ecologists to address the acidity.[10] In Tasmania, warming waters and intrusions of spiny sea urchins in large numbers have led to a loss of 95% of the giant kelp forests.[11] The loss of the kelp forests places a cultural keystone species at great risk—the rainbow mariner shells, icons of Tasmanian Aboriginal identity and representing women's governance of sea country.[12] Scientists and Indigenous Peoples are working together to try and restore the kelp forests by using the hopefully more resilient 5% of kelps that are still standing, providing hope for the mariner shells and for all the species dependent upon these underwater forests. These are "bright spots" laying the foundations for a global roadmap building on equity, interspecies respect, rewilding, and the restoration of "lost lands" for survival and resurgent communities. However, the questions of land rights and restitutive actions for traditional and Indigenous Peoples are at the heart of this resurgence—a lack of publicly enforced rights can undermine otherwise successful resource management and conservation practices by Indigenous Peoples and local communities.[13]

Working in genuine collaboration and partnership across knowledge systems is not always easy, and the authors here acknowledge many past mistakes, big and small. However, it is certainly possible, and there are abundant and plainly stated guidelines articulating sensible approaches for Western scientists to consider. Earlier this year, Kawerak, located in western Alaska, released a letter calling for the Indigenization of science.[14] This Indigenous organization raised a series of concerns regarding how research, research funding, and research prioritization have been done in the past. It highlighted a range of practical actions and outlined a constructive plan for a re-positioning of research agendas so that they are more appropriately inclusive toward Indigenous and local communities. This includes knowledge sovereignty. Much of this is in line with the writings of Maori scholar Linda Tuhiwai Smith,[15] who demonstrated through critical analysis how research actions frequently service colonial power and interests and often work against the wishes and well-being of Indigenous and traditional communities.

Another important approach was pioneered by Justice Thomas Berger in the 1970s when he was investigating aspects of the Mackenzie Valley Pipeline development in the Northwest Territories of Canada. Justice Berger transformed community research in Canada by simply *listening* (and then acting on what was said)—he listened to the Indigenous Peoples in their home areas, no matter how remote, in ways that they themselves expressed. Subsequently, dozens of Indigenous-minded and -focused research actions have improved on this legacy in the Arctic.

Reflecting as an Arctic scholar, author T.M. believes that the past 20 years of conducting climate-change research have brought forward the immediate need for the Kawerak advice and recommendations to prioritize research that matters to the people who used to be targets of colonial actions. Although science rhetoric has paid attention to these, it is fair to ask how much is actually changing globally in structural terms? Progressive, critical research often challenges societal power, economic models, land rights, and the status quo and legitimacy of structures exploiting natural resources. However, society has often responded in the past by acknowledging these findings with calls for more research while the lessons from people such as Justice Berger and Dr. Smith go unheeded, get buried, or get siloed into institutional arrangements rather than being more broadly mainstreamed.

A key component of the challenge in working across knowledge systems is the complex and often differing perceptions of reality. For example, Skolt Sámi leader Pauliina Feodoroff has expressed how environmental change and climate change are processes affecting more than just the landscapes—each change or loss is physically felt, especially by Indigenous women in and through their bodies, highlighting the cascading nature of impacts far beyond what is measurable by "standard science methods." Rewilding and restoration are not only a technical exercise but also a deep, multi-sensory (re-)engagement with landscapes. Many

Indigenous communities communicate with multi-dimensionally aware environments and non-human beings, embodying the concept that nature is an aware agency unto herself to which humans are intimately linked. In the past, the colonial and mainstream research community, with the exception of some individuals and specialized paradigms, appears to have found such insights rather unconvincing and mostly anecdotal. Only now is environmental science more broadly beginning, very tenuously, to grasp these ideas. The view of planet Earth as a living entity, so often shared by Indigenous communities, is very different from that derived from our shared global understanding based only on science. Coming to terms with this could have rather significant consequences for the future of environmental science.

Paradoxically, a challenge that can emerge from successful Indigenous-research partnerships is the "gatekeeper" problem. Those such as Justice Berger, often progressive scholars, become "the" experts on a people, region, or issue. The multiple knowledge streams and decentralized, grounded peoples and ways of knowing can be drowned out by (often male) gatekeepers who can provide, intentionally or otherwise, convenient messaging to policymakers, society, and the media. This often flattens the complex, multi-dimensional realities of Indigenous and traditional communities. In order to address this, the link between policy and research should move away from single "large solution," one-slogan headlines (e.g., Green Growth, New Deal, and Nature Finances) and toward the needs that are on the ground. This includes training and learning from the successes of the past, like Justice Berger and Maori Linda Tuhiwai Smith did. Ultimately, we must ask—from a position of humbleness, awareness, and non-imposition—what can research do, within the scope it has, to service and deliver for society, the planet, and its people?

Mapping the Road Forward

We know the old road of "business as usual" has come to its end. Where will we head from here?

The United Nations General Assembly declared 2021–2030 as the "Decade of Ecosystem Restoration," heralding hope for renewed global action. Such a roadmap is urgently needed and should preserve entire habitats where feasible by initiating landscape-level rewilding processes where habitats have the potential to recover. However, a global restoration and rewilding roadmap must be guided by both Indigenous knowledge and Western science. Moreover, Indigenous knowledge must be at the core of discussions and planning and not at the periphery. The roadmap has to be designed to include Indigenous- and community-governed approaches as a foundation to avoid the past mistakes of top-down conservation. As we can see from the Ekuri in Africa, restitutive land rights can be better achieved with co-design and co-implementation of conserved areas, and as seen in the Arctic Vainosjoki River case, rewilding can be a powerful vehicle for the realization of absent rights and the lack of opportunities for local communities.

We know now, from both Indigenous and scientific evidence, that a roadmap to global restoration is not only possible but also feasible financially and ecologically.[16] We need alternatives to market-led growth, and we need to access the huge potential that can be untapped via rewilding—new carbon sinks, new community-conserved biodiversity hotspots, and enhanced "green" and "blue" well-being. Such a roadmap will help solve our biodiversity crisis *and* can also address the urgent need for new sustainable approaches to our economies.

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